Demultiplexing of acoustic waves in a two dimensional ultrasonic crystal

Y. Pennec (1), A. Khelif (2), B. Djafari-Rouhani (1), A. Choujaa (2), S. Benchabane (2), J. Vasseur(1), V. Laude(2)
(1) LDSMM, Université de Lille1, Villeneuve d'Ascq, F-59650, France
(2) Département LPMO, Institut FEMTO-ST, F-25044 Besançon cedex, France.

We study the transfer of acoustic waves between two waveguides created in a phononic crystal. The two-dimensional crystal is a square lattice of steel rods in water, with a 3 mm period and a filling fraction of 0.55. Due to the strong contrast between acoustic impedances, this phononic crystal exhibits an absolute band gap from 250 to 325 kHz [1]. A full transmission band within the absolute band gap of the perfect crystal Is observed when a one period wide straight waveguide is created inside the phononic crystal [2]. Two such parallel waveguides can be coupled through a coupling structure exhibiting two perpendicular symmetry axes. The coupling element is constituted of isolated cavities interacting with stubs located at the sides of the waveguides. We observe that certain isolated frequencies are transferred from one waveguide to the other. We further study structures where the waveguide propagation band is due to the interaction between cavities [1]. More generally, we discuss the use of such devices for designing new acoustic or elastic waveguides, filters and demultiplexers.

[1] A. Khelif, A. Choujaa, B. Djafari-Rouhani, M. Wilm, S. Ballandras, V. Laude, Phys. Rev. B **68**, 0214301 (2003)
[2] A. Khelif, A. Choujaa, S. Benchabane, B. Djafari-Rouhani, V. Laude, Appl. Phys. Lett. **84**, 4400 (2004).